

the excitation frequency and/or at least one of  $\alpha/2$ ,  $\alpha/3$ ,  $\alpha/4$  times it are evaluated from the ultrasonic signal received from the ultrasonic converter, reflected from the examination area or backscattered from the latter.

2. Ultrasonic process, especially for objects limitedly resistant to sonic intensity, for selective graphic representation and/or evaluation of the Doppler spectrum, in which

a material is introduced in the examination area to be acoustically irradiated with which nonlinear oscillations in this area are produced by irradiated ultrasonic waves,

a broadband, acoustically highly damped, electrically matched ultrasonic converter with one or more controllable converter elements individually or assembled in groups, is excited by two HF bursts, whose respective excitation frequencies are different from one another, and are smaller than half the frequency upper limit of the operating range, and

signal combinations of both excitation frequencies, especially their sum frequency, are evaluated from the ultrasonic signals received from the ultrasonic converter, reflected from the examination area or backscattered from the latter.

3. Ultrasonic process according to claim 1 or 2, wherein the material contains stray elements producing nonlinear oscillations.

4. Ultrasonic process according to claim 1 or 2, wherein the material is an ultrasonic contrast medium in the form of a solution, emulsion or suspension.

5. Ultrasonic process according to claim 1 or 2 or 4, wherein the microbubbles or agents producing microbubbles are the material.

6. Ultrasonic process according to claim 4 or 5, wherein a microbubble suspension with a concentration of  $10^{-3}\%$  by weight to 30% by weight of dry substance is introduced in the suspension medium.

7. Ultrasonic process according to at least one of claims 1 to 6, wherein the ultrasonic converter is excited by at least one

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function generator, with which HF bursts of adjustable amplitude and adjustable excitation frequency ( $f_0$ ) are produced in the range of 0.3 MHz to 22 MHz, preferably 1 MHz to 11 MHz, and with 0.5 to 20, preferably 1-5, periods.

8. Ultrasonic process according to at least one of claims 1 to 7, wherein frequencies that are smaller than ultrasonic converter center frequency ( $f_T$ ) are evaluated.

9. Ultrasonic process according to at least one of claims 1 to 8, wherein at least one period is selected and the related frequency spectrum is determined in an analog or digital manner in the evaluation by a computer-controlled gate circuit.

10. Ultrasonic process according to claim 9, wherein the time window length and number of periods per burst is adjusted depending on the desired frequency resolution and high-sensitivity resolution.

11. Circuit for performing the process according to at least one of claims 1, 3-10, characterized by

1. a function generator (1), whose output (2) is connected by

2. an T/R switch (3), synchronized by function generator (1), from which a signal processing system is downstream,

3. is connected to the oscillator of an acoustically highly damped, electrically matched, broadband ultrasonic converter element (4).

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12. Circuit for performing the process according to at least one of claims 1, 3-10, characterized by

1. a function generator (1), whose output (2) is connected to
2. the input of the ultrasonic converter,
3. whose output is connected to a signal processing system.

13. Circuit according to claim 11 or 12, wherein the sonic intensity radiated by the ultrasonic converter exhibits, as a function of the frequency in the frequency range below ultrasonic converter center frequency ( $f_T$ ), a positive first derivative with respect to the frequency, which is constant especially in operating range ( $f_{0 \min} < f_0 < f_{0 \max} < f_T$ ) or wherein this sonic intensity has a constant value in this frequency range.

14. Circuit for performing the process according to at least one of claims 1 or 3-10 with a multielement ultrasonic converter with n-phase-delayed, actuated ultrasonic converter elements, characterized by

1. a function generator (1), whose output (2) is connected
2. by an n-path signal divider (5),
3. n computer-controlled delay circuits  
(7.1.1...7.n.1)
4. and n T/R switches (3.1.1....3.n.1) controlled by function generator (1) or a computer, to

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5. the inputs of the ultrasonic converter elements,  
whose

6. outputs are connected by  $n$  T/R switches  
(3.1.1...3.n.1) to, in each case, an

7.  $m$ -path signal divider (10),

8. which are connected respectively by  $m$  delay  
circuits (11),

9.  $m$  fixed or variable circuits (12) for frequency  
band selection and

10. a circuit for in-phase summation and optional  
signal distribution

11. to a system for selective further processing --  
individually or parallel -- of  $m$  frequency bands.

15. Ultrasonic process according to at least one of claims  
2-6, wherein

the two HF bursts are produced by two function generators and  
are fed either to an ultrasonic converter element or to two  
ultrasonic converter elements, and wherein with each function  
generator, HF bursts of adjustable amplitude and adjustable  
center frequency ( $f_0$ ) are produced in the range of 0.5 to 20 MHz,  
preferably 1 to 5 MHz with 1 to 25, especially 1 to 10, periods.

16. Circuit according to at least one of claims 11-13 for  
performing the process according to claims 2-6, characterized by  
a second function generator which is connected either by S/E  
switch (3) to the input of an ultrasonic converter element or  
directly to the input of an additional converter element.

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17. Circuit according to claim 14 for performing the process according to claims 2-6, characterized by a second function generator (1) which can be turned on by an n-path signal divider on n delay circuits (7.1.1-7.n.1).

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B<sub>1</sub>

Add e<sub>1</sub>  
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